THE IMPLANTATION OF SILVER FILIGREE FOR THE CLOSURE OF LARGE HERNIAL APERTURES.[1]

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LARGE hernial apertures are frequently met with in surgery. They are always a source of more or less perplexity and concern to the surgeon called upon to relieve the condition. They occur as a result of long existing ruptures with atrophy of the adjacent muscular and fibrous tissues, but more frequently in consequence of previous surgical intervention (recurrent hernia, prolonged drainage, faulty asepsis, etc.).

In his efforts to close these large defects, it is the surgeon's aim to make use of the tissues as found in the patient himself, whenever possible. Thus, for instance, in the case of a large umbilical or ventral hernia of the linea alba, we split the sheath of the recti muscles, loosen their belly, move them towards the median line, and stitch them together by means of chromicized catgut, kangaroo tendon, or silver wire (Gersuny, *Centralblatt für Chirurgie,* 1893, No. 43); or, when dealing with an umbilical hernia, we can also make a plastic operation according to Piccoli (*Centralblatt für Chirurgie,* 1900, No. 2). In case of a wide gap in the abdominal wall in the appendix region, where the normal borders cannot be reunited, we utilize the outer half of the rectus muscle for transplantation into the defect. As regards the treatment of large defects in inguinal and femoral herniæ, Trendelenburg was the first who successfully sutured a disk, taken from the head of a recently resected humerus, into the aperture (*Report of German Surgical Congress,* 1890, i, 133); later he modified his procedure by turning into the hole a pediculated periosteal bone flap that had been chiselled out of the patient's pelvis. The same procedure was recommended by Kraske and Körte (*Handbuch der praktischen Chirurgie,* Vol. iii, p. 645).

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Although in possession of these various useful methods, we nevertheless occasionally encounter herniæ of such enormous dimensions that we know beforehand we cannot permanently cure them by any of the aforementioned procedures. Such cases have been hitherto considered incurable, and many surgeons, apprehending the negative result, have refused operation. Yet it is just this class of patients who most urgently request and need surgical help.

It is, therefore, gratifying to know that the implantation of silver filigree bids fair to fill this gap in our therapeutic resources.

Schede was the first to champion the use of silver wire in closing abdominal incisions with a view to preventing a subsequent hernia. His sutures embrace the entire thickness of the abdominal parietes exclusive of the skin. He has practised this method for many years, and has never since seen a ventral hernia occur after any of his abdominal operations where the wound could be thus closed (*Centralblatt für Chirurgie,* 1900, p. 257, foot-note).

The discovery of the strong antiseptic properties of silver, by Credé, gave a fresh impetus to the more extensive use of this material in operative surgery.

In 1900, O. Witzel, of Bonn, published his method for the closure of abdominal wounds and hernial apertures by means of buried silver-wire netting (*Centralblatt für Chirurgie,* 1900, pp. 257, 457, and 1149). He uses wire of different thicknesses, and aims to prevent the appearance of a ventral hernia by arranging his sutures in various directions and layers across the opening, leaving the net-work of wire thus produced permanently in place. The ends of the suture are always twisted with the fingers, the cut ends being left about one centimetre long, and held down by the subsequent superficial wire sutures in such a way as not to give rise to future annoyance by pricking from within. For the cure of recurrent hernia after the failure of one of the radical methods now in general use (Bassini, Kocher), buried wire netting of larger dimensions is made use of. In these cases the peritoneal cavity is not opened if it can be avoided. First, the borders of the hernial opening, after proper exposure, are brought into closer proximity by means of interrupted wire sutures of medium size, which are made to cross one another, or by a continuous suture, as the case may require, without producing undue traction. A needle with a long piece of much finer silver wire is then plied transversely and obliquely across these sutures until a regular fine net-work has been formed. The peritoneum is included in these sutures whenever necessary in order to avoid dead spaces. Witzel thinks that the wire net-work should be at least three times the size of the hernial aperture. He states, "the farther the sutures are carried beyond the border lines of the opening the better will be the result," since pressure and constriction of the enclosed tissues will thus be less likely to be produced. As above stated, he forms the netting himself within the wound during the operation, and gives special directions as to how to proceed in the different varieties of hernia.

The publication by Witzel of his method of closing abdominal defects with silver-wire netting induced R. Göpel, of Leipzig (*Centralblatt für Chirurgie,* 1900, No. 17, p. 458), who had been working along similar lines for some time, to also make public the result of his own experience with the implantation of *ready-made* silver-wire netting as a means of closing hernial apertures, so that these two communications came to be published almost simultaneously.

Göpel's report covers a period of more than three years, the first operation having been done in March, 1897. He points out the following advantages of the ready-made silver filigree over the self-made wire netting:

(1) The tissues bordering the hernial aperture are less exposed to injury and constriction;

(2) The time required for the operation is reduced;

(3) The meshes of the ready-made wire pad are of equal and regular dimensions; a diastasis, even of small size, is less often met with;

(4) The amount of silver wire left within the wound is reduced to a minimum.

In cases of umbilical and ventral hernia the shape of the net is round, oval, or quadrangular, with blunt corners; it is sutured upon the aponeurosis of the abdominal muscles bordering the aperture.

In inguinal hernia the net has the shape of an acute-angled triangle with the base turned towards the median line, where a small excision has been made for the spermatic cord. It rests on the internal oblique or transversalis muscle. The sides of the triangular wire pad are attached to Poupart's ligament below and the muscles above.

Göpel's report comprises eleven cases of umbilical and ventral hernia and seven cases of inguinal hernia in which the implantation of silver filigree, just referred to, was practised, with but two failures. In the latter the formation of a hæmatoma necessitated the removal of the netting. In some of the successful cases the hernia was the size of a child's head. The largest net implanted was 10½ by 17 centimetres (4 by 6¾ inches) in size. By taking proper care in securely fastening the borders of the wire pad, even patients of the working-class were not molested by the presence of the foreign body.

In the United States, A. M. Phelps, of New York, has worked in the same direction since 1892. On the basis of his experience with silver wire, he recently advocated the discarding of all absorbable suture material (chromicized catgut and kangaroo tendon), now so universally and successfully employed in our radical operations for hernia, in favor of silver wire (*New York Medical Record,* September 22, 1900). To forestall the possible relapse of a hernia, he promptly fortifies "the inguinal canal with a mattress of wire, stitching the muscular layers over it, entirely obliterating the inguinal canal, bringing the cord out underneath the skin, and cutting the aponeurosis of the muscles so as to prevent strangulation of the cord." The sutures are continuous, sometimes arranged in layers. Abdominal wounds he closes with silver wire and fortifies them. Since 1892, 216 cases of hernia have been thus treated; among these were forty-six relapses after Bassini's and fifty-one after other operations.

However, as the title indicates, the purpose of this paper is not to discuss the usual radical operation for hernia, but to deal with large defects in the abdominal wall that cannot be closed by any means other than heteroplasty.

After having personally employed Gersuny's method for a number of years to my entire satisfaction (ANNALS OF SURGERY, 1900, Vol. xxxi, pp. 746 and 747), and having also given the transplantation of the external half of the right rectus muscle a trial in a case of large rupture in the appendix region following drainage, a patient came under my care last summer in whom any kind of autoplasty was absolutely out of question. The history of the case is as follows:

CASE I.—Male, aged fifty-five years; butcher; was operated upon for strangulated hernia, March 17, 1898, by another surgeon. Wound was left open. He was discharged from the hospital after eleven weeks, with the wound healed and a beginning hernia. All forms of trusses being uncomfortable, the defect in the abdominal wall was left unprotected for several years, in spite of heavy bodily work. June, 1901, the pain became unbearable. Admitted to German Hospital with large ventral hernia; insisted upon operation; ready to take any chances.

Operation, June 13, 1901.—Circumcision of scar; peritoneum opened; careful dissection of manifold adherent intestinal coils. Poupart's ligament cannot be distinguished; seems missing. Enormous gap extending from border of atrophied and unyielding abdominal muscles to horizontal part of pubic bone. I decided to try and close the opening with silver-wire netting. Eight to ten interrupted sutures of heavier wire are used for the deep layers; moderate tension is brought to bear upon these in order to bring the superior border line of the defect as closely as possible to the line of the pectineal fascia and periosteum of the pubic bone. These sutures are then interwoven in all directions by long, continuous sutures of silver wire of finer grade. The needle is passed up to a line fully one to one and one-half inches above the aperture. The beginning of a new thread is twisted to the end of the former one. The work is difficult on account of the immediate proximity of femoral and external iliac vessels, which appeared exposed for a distance of several inches. The vein, pulled outward by a blunt retractor, immediately adjoins the inner border of the netting. Suture of remaining shreds of fascia and of the skin by means of catgut without drainage completes the operation. Very little reaction. Primary union throughout. After a while a small sinus, discharging serum, forms at inner angle of scar. The same closes within about six weeks. For safety's sake, the patient is kept on his back for eight weeks. He is discharged on the 19th of August without a truss; result perfect. Ten days later, in spite of my advice to the contrary, he is back at his former heavy work; after two to three weeks the sinus reopens, discharging slightly. It is left undressed and patient continues his work.—First examination of patient after operation, November 18: Silver pad protects aperture nicely. At its upper, outer angle, near the anterior superior spine, a hernia of small dimensions is noticed, which is said to have appeared about four weeks ago when carrying a heavy piece of meat. It corresponds to the direction of the femoral vessels. Additional operation and attention to fistula advised. Seen again May 26, 1902: Condition about the same; fistula closes and reopens; no medical attendance. Patient states that he has been greatly benefited by the operation and is perfectly able to attend to his heavy work.[1]

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[1] On June 7, when lifting a cake of ice from the wagon and carrying it into the store, the patient felt a sudden intense pain within the abdomen. He soon had to quit work; vomiting set in; passage of gas ceased. Two days later he was brought to the hospital in poor condition; operation was promptly performed. It was found that an incomplete intestinal obstruc-

Case II.—Mrs. H. F., aged forty-three years. In 1894, vaginal hysterectomy was performed for myoma by one of New York's gynæcologists. Five weeks later, bilateral oophorectomy. After another month, extirpation of left kidney on account of ureterovaginal fistula. Soon after being out of bed, a ventral hernia appeared at the site of the median incision. Abdominal supporter badly borne; therefore radical operation for the cure of the hernia by a well-known surgeon of New York. (1898.) Good result. One year later, when carrying coal up the cellar-stairs, sudden reappearance of the hernia. Further operation refused by a number of surgeons. The patient was first seen by me in February, 1900. Very large, irreducible omento-intestinal hernia; aperture about midway between symphysis and umbilicus. Patient demands surgical help.

Operation, March 1, 1900.—Dissection of intestines and omentum difficult, as they are matted together by dense adhesions with the parietal peritoneum. Reduction in Trendelenburg's posture. Aperture is round, larger than palm of hand. Autoplasty out of question. In order to shut off the peritoneal cavity, the omentum is drawn down tautly and stitched to the parietal peritoneum near the border of the gap by means of numerous interrupted sutures of chromicized catgut. The parietal peritoneum is then closed by a continuous suture on top of the omentum. The remnants of superficial fascia and subcutaneous scar tissue are preserved and stitched together as well as is possible. Continuous suture of skin. Primary union throughout. After six weeks the patient is allowed to get up with abdominal supporter, and soon

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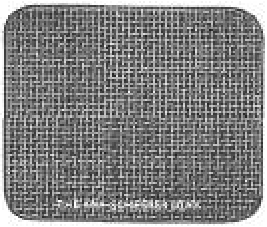
tion, due to manifold old-standing adhesions between coils of the small intestine, had suddenly become complete; beginning peritonitis in the neighboring coils. The wire netting had no relation to the trouble. The patient died soon after the operation. Only a very limited and hurried post-mortem could be done, during which the netting was removed *in toto* with the surrounding tissues. It is seen that the internal and external tissues have grown through the interstices of the netting, the whole thus forming a solid wall of great strength. According to the report of the assistant who made the post-mortem, a few loops of intestine had made their way downward alongside the great vessels, but these were found not to be involved in the trouble.

Surely, the netting as such had served its purpose; it had enabled the patient, an absolute invalid before the operation, to resume his heavy work for months without wearing any kind of supporter or protection.

after is discharged.[1] She could rejoice once more over the cure effected, feeling, as she said, like a new-born person, and being well able to resume her former arduous occupation (general housework). However, her happiness was not to last long. In July, five months after the last operation, after a mistake in diet, followed by severe vomiting, she suddenly felt something give way at the hernial orifice. As shown by the conditions revealed at the later operation, the spasmodically contracting stomach had pulled the omentum off the right lower circumference of the hernial opening. When I saw the patient again in March, 1901, a large hernia had reappeared, causing her great annoyance. In this condition she was presented before the New York Surgical Society (ANNALS OF SURGERY, 1901, Vol. xxxiv, p. 572), with the statement that another attempt at a radical cure, with the help of silver-wire netting, was contemplated by me. This operation was done June 29, 1901, at the German Hospital: Longitudinal incision as before; excision of skin scar. Omentum has torn loose from right lower circumference of aperture. Intestines have pushed forward. Reduction in Trendelenburg's posture; omentum again stitched to border. That part of parietal peritoneum which formerly represented the hernial sac tears in many places and cannot be preserved. Then, after sufficient undermining of the subcutaneous fat layer, a ready-made silver filigree pad, six by four inches (Fig. 1) (which I procure through the Kny-Scheerer Company, of New York), thoroughly sterilized by boiling, is placed upon the defect. It rests upon the omentum and adjoining abdominal wall, where it is stitched to the underlying fascia by a continuous suture of heavy silver wire. After this the fat wound is closed by a few far-reaching, deep, and a great number of more superficial silkworm-gut sutures. There was no reaction. The upper portion of the wound healed by primary union. In the lower half localized fascia necrosis caused temporary suppuration. Nevertheless, the wound closed definitely after a while and has remained closed up to date. In view of her weight (250 pounds), it was thought best to keep the patient on her back for eight weeks. She then got up, requiring no support, the rupture having been radically cured. The wire pad, while palpable, caused

FIG. 1.



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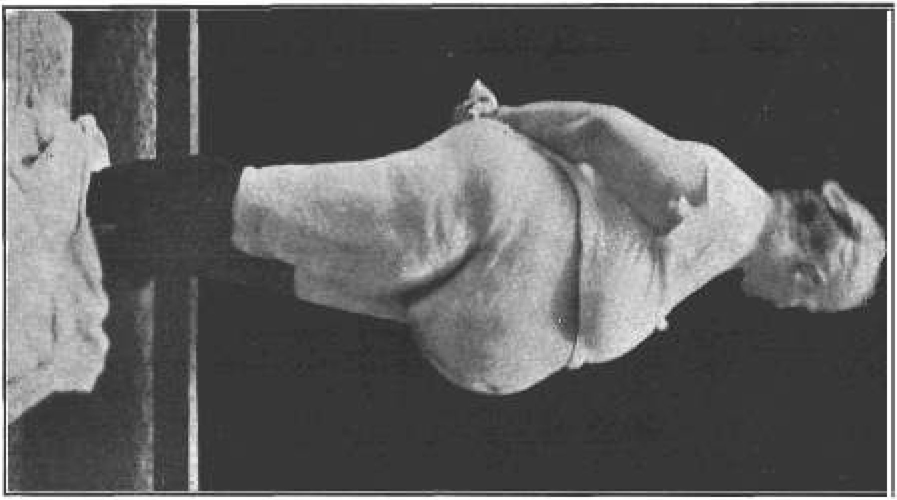
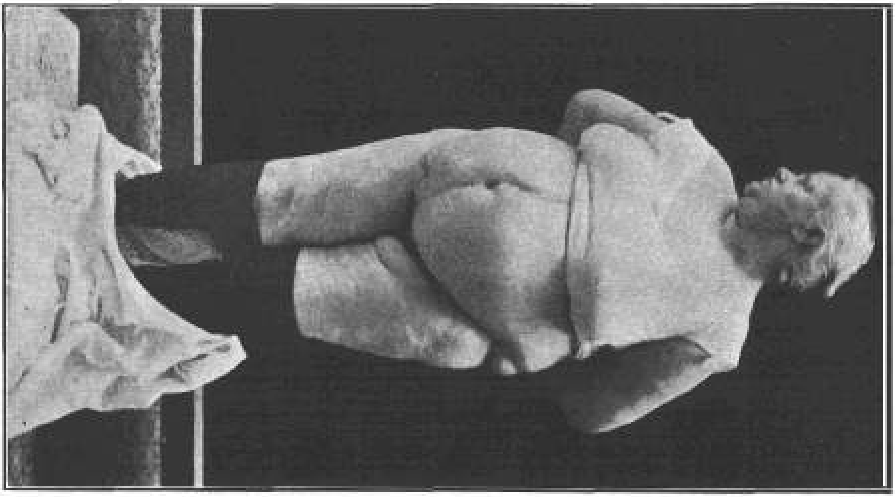
[1] *Shortly afterwards she developed an epigastric hernia of small size, directly above the umbilicus, which also was successfully operated upon at the hospital.*





the patient little discomfort. Only on and off she noticed some slightly painful sensation in the region of the scar. On returning home, she was obliged to immediately resume her former heavy work, which often severely taxed the firmness of the plate. The latter stood the test well, however, in always successfully resisting the increased intra-abdominal pressure.

In the early part of October, when washing dishes, standing in front of a low kitchen sink, she struck the region of the protected hernial opening against the corner of the sink. A sudden, intense pain almost made the woman faint. Yet no injury could be detected when I examined her a few days later. Developments since have shown, however, that she must have torn the continuous suture at the time of the accident, causing one of the corners of the well fastened filigree pad to come loose; for to-day I am able to palpate in the right lower circumference of the original rupture a slight omental protrusion. Nevertheless, the patient feels well and experiences little discomfort from this cause. Several attempts to demonstrate the position of the pad on a radiograph were unsatisfactory, probably on account of the patient's immense circumference. (Figs. 2 and 3.) It is my intention to reopen the scar and repair the defect by placing an additional netting *in situ* just as soon as this can be arranged. I confidently expect to see the patient, with a little bit of personal care, at last remain permanently in the same satisfactory condition that the former three attempts at a cure had always been successful in effecting temporarily.

In order to more securely guard patients against harm from such accidents as the one just described, I shall in future similar cases fasten the plate by a second continuous suture of wire.

CASE III.—Mrs. M. S., aged thirty-one years; nullipara. About a year ago first noticed a reducible, small tumor in the region of the umbilicus. For this she wore an abdominal supporter with a special pad. Within the last week the hernia had become irreducible, hard, and painful. When first seen by me, March 12, 1902, a tumor, the size of a cherry, was visible in the region of the umbilicus. It appeared to be an irreducible, inflamed, umbilical omental hernia. Ice and rest soon reduced the inflammation. Reduction, then feasible, showed the neck of the rupture to be about one-half to three-quarters of an inch to the left of the umbilicus, the contents of the sac causing the latter to protrude considerably. In view of the annoyance attendant upon the wearing of a bandage, and the recent inflammation in all probability caused by the same, the patient readily agreed to have the proposed radical operation performed. On April 2, 1902, omphalectomy. It was seen that the hernia had been caused by a retraction of the left rectus muscle. Whereas the right rectus muscle immediately adjoined the median line, the left made a pronounced curve at a level with the umbilicus. In order to carry out Gersuny's operation, it would have been necessary to make an incision from the xiphoid process to the symphysis, with extensive dissection of the left rectus muscle; and this, in view of the large amount of adipose tissue (patient's weight being 190 pounds) and the tense, unyielding character of the patient's abdomen, did not seem advisable, especially as a satisfactory result seemed by no means insured by such procedure. I therefore decided upon the implantation of silver filigree. A pad, three and a half by four inches, was placed upon the aperture, which latter was as large as a silver dollar. Again the omentum was utilized to protect the intestines in the same manner as in the preceding case. Then the two skin fat flaps were reflected sufficiently to make room for the plate. A continuous wire suture was run around the border to hold the netting in place. Wound closed with silkworm-gut sutures; two minute rubber-tissue cigarette drains at either end. These were removed on the third day after the operation, when the wound was found to have healed by primary union throughout. At the end of the third week the patient was carried home, with instructions to remain on her back for another week. To-day she is entirely well, and so far not annoyed by the heteroplasty.

The foregoing three cases are sufficient, I think, to show that the class of herniæ, formerly considered inoperable on account of the size of the defect in the abdominal wall, are still amenable to treatment by the method just reported. In spite of great intra-abdominal pressure, this artificial, subcutaneous, or submuscular pad does not yield, firstly, because it is securely held in place by the silver-wire sutures, and, secondly, because the little lobules of fat are pressed through the meshes, and thus the scar tissue below and above becomes a unit with the neighboring tissues.

A most interesting and important feature of this kind of heteroplasty is the fact that it remains *in situ,* undisturbed, even though the wound should not heal aseptically, or suppuration, in consequence of a localized fascia necrosis, etc., should set in.

Witzel observed this fact and calls attention to it. Phelps emphasizes it, and, in the event of wound infection, advises "a small incision of the sinus, curetting of the infected portion, and filling of the wound with pure carbolic acid, which is afterwards washed out with alcohol."

My first case above reported also nicely illustrates this point. Evidently the antiseptic properties of silver are responsible for this phenomenon. It places this kind of heteroplasty in favorable contrast with other kinds, as, for example, celluloid, aluminum plates, etc. It represents one of the chief advantages of the method, and explains the success that has thus far attended its use in replacing a defect of the lower jaw (C. Hofmann, *Centralblatt für Chirurgie,* 1900, p. 1145); or in covering a defect in the trachea (Grosse, *Centralblatt für Chirurgie,* 1901, p. 1110); in replacing the diaphysis of the tibia, which had become entirely lost by necrosis (Hofmann, loc. cit.). In localities that can be rendered and kept sterile, it has proved of greatest value, thus, for instance, in covering a defect in the skull after trephining (A. Gleich, *Centralblatt für Chirurgie,* 1900, p. 412); in supporting a movable kidney (Witzel, *Centralblatt für Chirurgie,* 1900, p. 1149), etc.

There can be no doubt, I think, that the field of its usefulness will be widened as we gain further experience. I believe, for example, that it would prove of great value in cases where a certain area of the abdominal wall as such, including the parietal peritoneum, had to be excised on account of a tumor (fibroma, fibrosarcoma, etc.). In such cases, I think it would be wise, wherever this can be done, to first pull down and stitch to the border of the aperture the omentum—same as I have done it in two of my cases—in order to properly protect the intestines against injury from the implanted foreign substance.

On reviewing the results that have been thus far obtained with silver wire and silver-wire filigree in closing large, otherwise intractable hernial apertures, it seems to me, we may well say, that this new style of heteroplasty deserves the earnest consideration of every surgeon.